Interfacing Servo Motor with AVR (Firebird V)

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Agenda of Discussion

1. Introduction
2. Servo motor
   - Principle and Working
   - Operating Servo Motor
   - Selection of Servo motor
3. AVR ATmega2560
   - Generating PWM signals
   - Code

Prerequisite knowledge

1. Basic IO Interfacing using ports
2. Working with Timers and basic knowledge of registers of ATmega2560.

Introduction

- Servo motors (or servos) are self-contained devices that rotate or push parts of a machine with great precision.
- Servos can put out about 42 oz/in of torque.
- Relatively inexpensive.
- Widely used for educational purpose in mechatronics as they can be controlled by a microcontroller.

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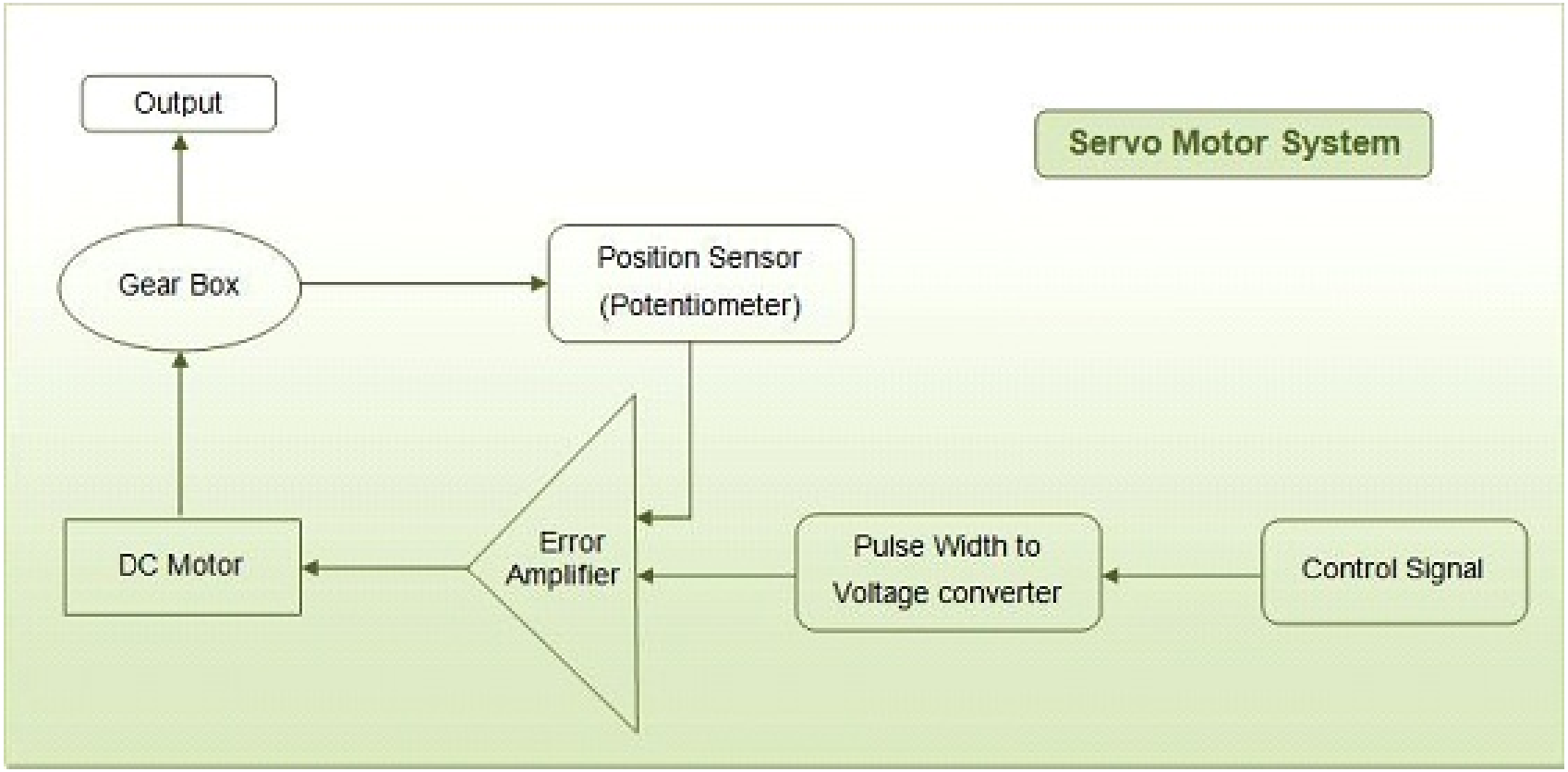
  - control circuitry.
- Forming closed loop control system.


Servo Motor System
Output
Gear Box
Position Sensor
(Potentiometer)
DC Motor
Error
Amplifier
Pulse Width to
Voltage converter
Control Signal

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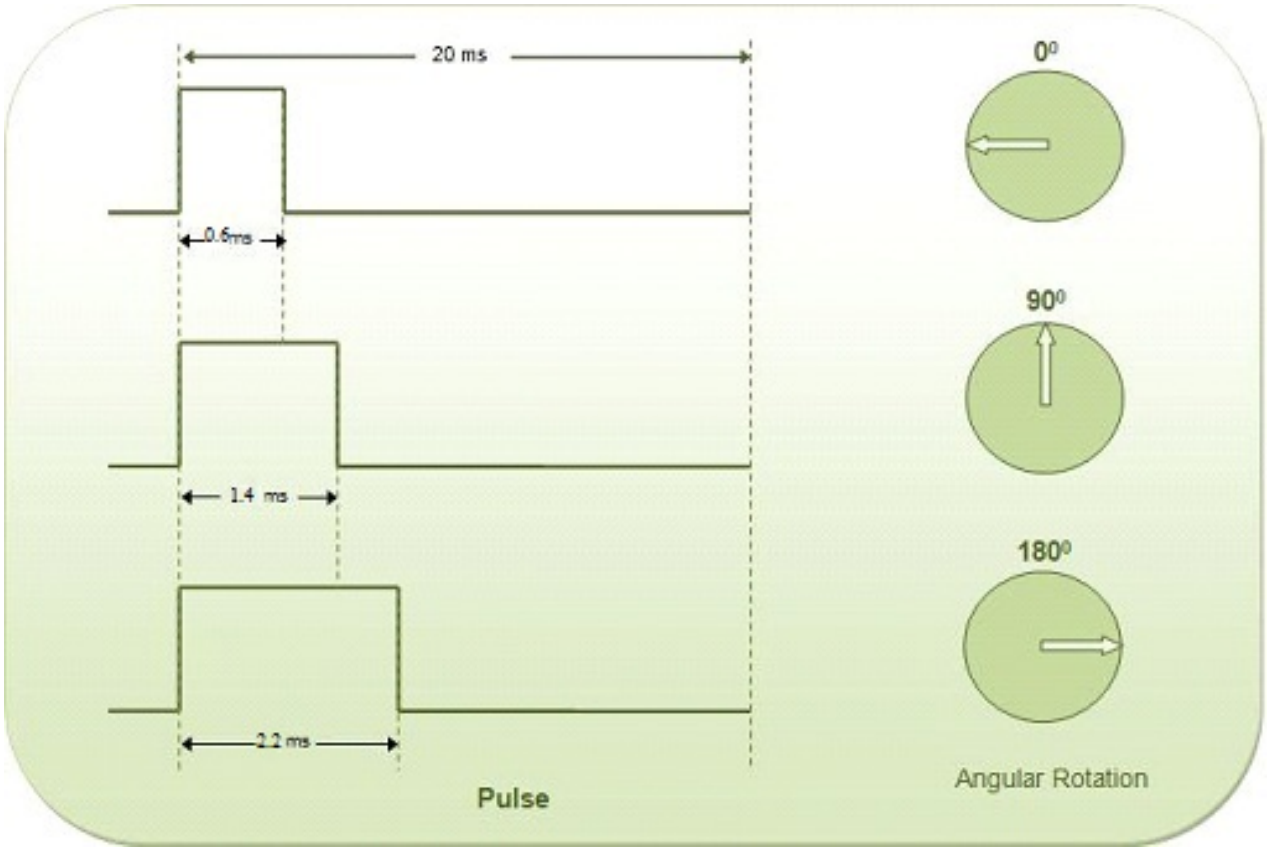
- Resultant signal from error detector acts as input to the dc motor to rotate.
- Also rotating the potentiometer knob coupled with its shaft via gears.
- Reaching desired angle, there would not be any difference in the signals fed to error detector.
- Resulting in motor to stop rotating and wait at that position

Operating servo motor

- 'on-time' of a PWM signal is used as control signal to rotate motor at particular angle.



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- Graph of on-time period vs. angle is linear.
- Range of PWM frequency for operating servo is 40-60 Hz

Selection of Servo motor

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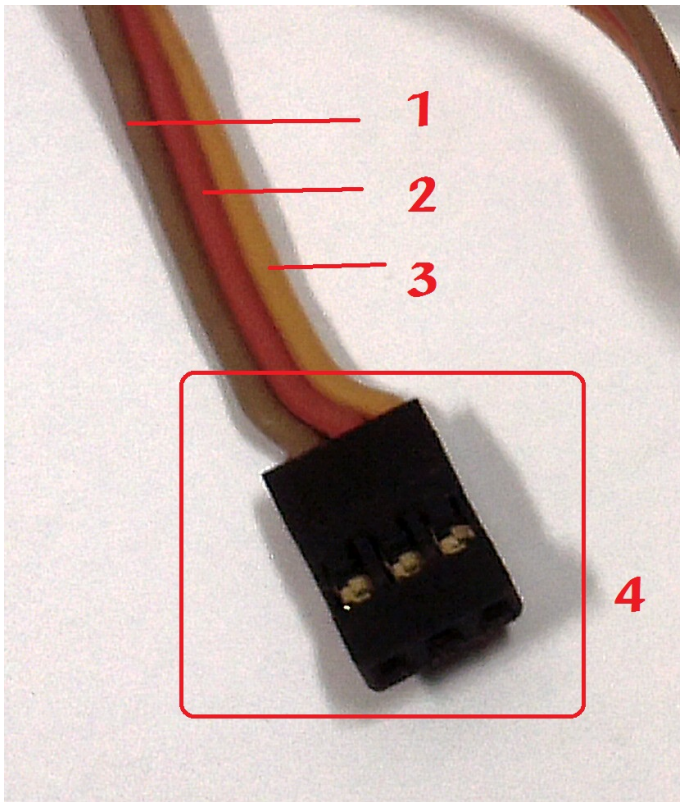
Selection of Servo motor

Servo is selected based on its:

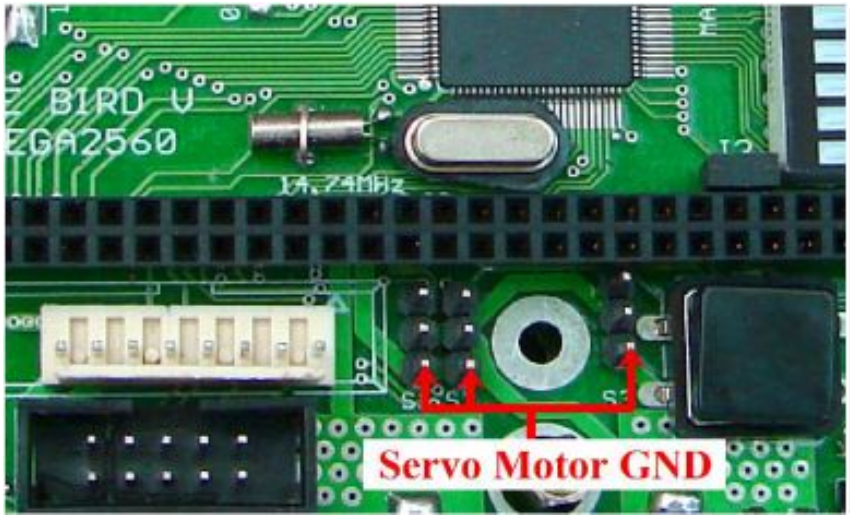
- Torque
- Speed
- Weight
- Dimensions

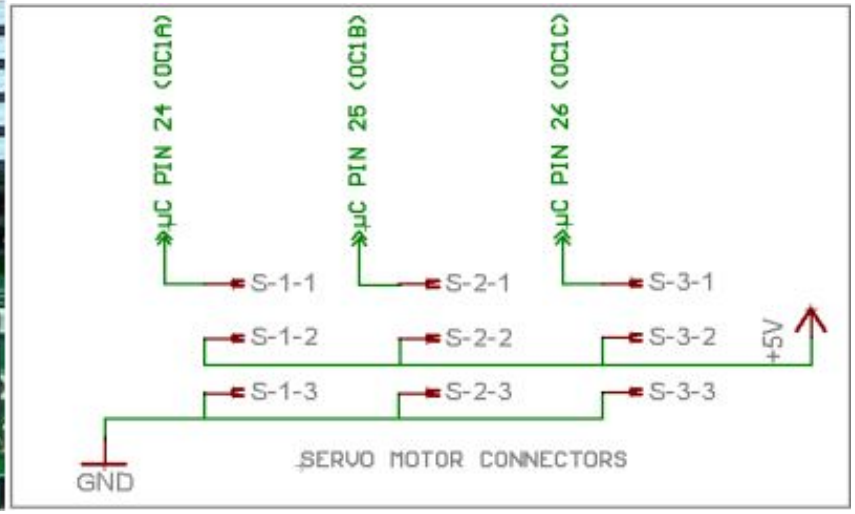
Servo connector



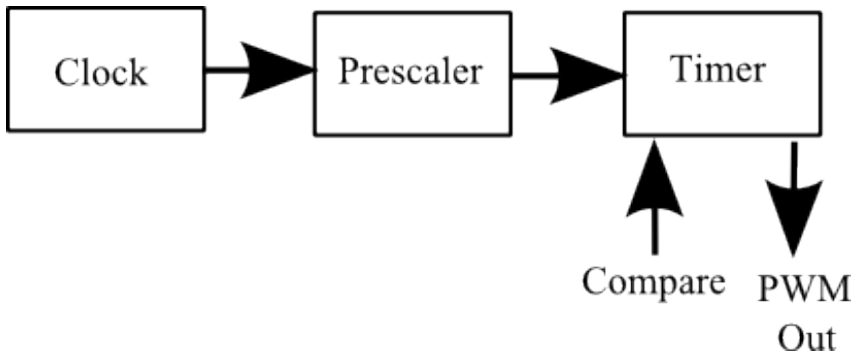
- 1– Ground
- 2– Power
- 3– Control signal
- 4– Connector to controller

Interfacing servo with Firebird V





Using Timer1 for PWM generation



- Timer1 in Fast PWM mode is used here.
- Fast PWM in mode 14 is used to rotate servo motor.

11	1	0	1	1	PWM, Phase Correct	OCRnA	TOP	BOTTOM
12	1	1	0	0	CTC	ICRn	Immediate	MAX
13	1	1	0	1	(Reserved)	–	–	–
14	1	1	1	0	Fast PWM	ICRn	BOTTOM	TOP
15	1	1	1	1	Fast PWM	OCRnA	BOTTOM	TOP

WGM bit description

Generating PWM signals contd.

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- Clears the output when the count value matches the value in compare register till the next cycle starts.
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- $f_{cpu} = 14745600Hz$

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- Value of channel A of OCR register will be:
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- Values of registers like TCCR1A/B and TCNT1 can be found using ATmega2560 datasheet.

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Port Initialization

```
void port_init()
{
DDRB = DDRB | 0x20;
PORTB = PORTB | 0x20;
}
```

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As the relation between on-time period and corresponding degree is linear, so is the relation between the count value in OCR and degree.

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```
float regval = ((float)degrees * 0.512) + 34.56;
OCR1A = (uint16_t) regval;
```

Thank You!

Post your queries on: helpdesk@e-yantra.org